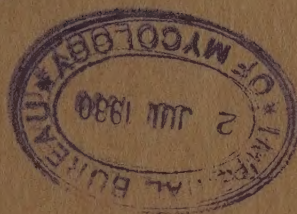


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CONFERENCE OF EMPIRE METEOROLOGISTS, 1929.

AGRICULTURAL SECTION.



AGRICULTURAL METEOROLOGY

IN

NEW ZEALAND.

A. METEOROLOGICAL RECORDS.

Forty climatological stations are maintained. Observations are made daily at 09.00 hours and cover temperature, humidity, wind, cloud, precipitation and weather. A proportion record, also, earth temperatures and sunshine.

In addition, rainfall is recorded at 400 well distributed stations. Weather phenomena, wind and cloud are also recorded at the majority of these stations.

Thermograph and hygrograph records are kept at the Massey Agricultural College and at Wellington.

At Alexandra, in Central Otago, where a special station has been established in connection with experiments in frost protection, in addition to the ordinary equipment, thermographs are kept in operation. Advice and assistance are given to fruit growers in connection with the experiments.

Evaporimeters are being established at Alexandra, the Massey Agricultural College and the Canterbury Agricultural College. Records are already kept at a number of places by the Public Works Department.

Stations in the Chatham Islands, the Cook Archipelago, and at Niue are included among those referred to above.

Results are published monthly and annually and are available to subscribers on payment of the cost of postage.

Assistance through advice or the loan of instruments is given through the Department of Scientific and Industrial Research in the case of numerous investigations connected with Agricultural problems.

Upper air observations will shortly be commenced at two or three stations in New Zealand and Agriculture will benefit indirectly from the knowledge thus obtained.

It is hoped that quantitative measurements of solar radiation will be made shortly by means of continuously recording apparatus.

In addition to the New Zealand service, that in the Mandated Territories of which the Centre is at the Observatory at Apia, Western Samoa, is also controlled by the Department of Scientific and Industrial Research. In addition to work in terrestrial magnetism, atmospheric electricity and seismology, the Observatory undertakes a comprehensive program in meteorology.

Records of solar radiation are kept at the Observatory with a recording instrument of the Gorczynski type. Measurements of the intensity of ultraviolet light are also to be undertaken shortly. Upper air observations by means of pilot balloons are made regularly and have yielded valuable results.

The observatory is fitted as a first-class meteorological observatory and has continuous records of wind, pressure, temperature, sunshine and humidity. Evaporation and earth temperatures also are recorded. The results are of particular importance since the island has a climate typical of the trade wind zone.

Out stations are maintained at Atafu, 350 miles north, and Puka Puka, 300 miles east.

Apia is also the co-ordinating centre of an organisation whereby weather reports and storm warnings for the Western Pacific are issued by wireless telegraph. The reports cover a wide network of stations from Vila, in the New Hebrides, in the West to Ocean Island in the North, Papeete in the East and Norfolk Island in the South. During the hurricane season from the 1st November to the 30th April reports are broadcasted twice daily at 23.30 G.M.T. and 08.30 G.M.T. respectively. If there are signs of a disturbance a special warning addressed to all stations is broadcasted. At other times than the hurricane season the 08.30 G.M.T. message only is issued.

The storm warnings are of great importance to agriculturists as well as to shipping.

Data are published monthly and annually.

This is a new country and it is not possible to provide so close a network of stations or so complete an instrumental equipment at them as in the more thickly populated countries. Improvements in this direction will inevitably be gradual.

On the other hand, the variations in some climatic factors and in soil factors are very considerable. Owing to the mountainous nature of the greater part of the country, also, topographical considerations are very important.

At the present stage it is not known what are the factors of most importance in connection with the various farming activities and on which attention should be most concentrated. The following is probably the order of importance of the subjects to be considered:-

1. Pasture,
2. Dairy Stock.
3. Wheat,
4. Sheep,
5. Fruit.

The meteorological factors of most importance, and the critical seasons, are different for each of these items.

Investigations into some of the meteorological factors such as radiation, soil moisture, etc., where considerable technical skill is required, will probably have to be confined to a few centres, each of which may perhaps specialize in certain directions. The institutions best fitted to take up such work would probably be the Massey Agricultural College at Palmerston North, the Canterbury Agricultural College at Lincoln, and the Cawthron Institute at Nelson. The needs of important

districts in the Auckland, Taranaki, Hawkes Bay and Otago provinces, which have special problems, would not be adequately covered by such a restricted scheme. There are, however, agricultural institutions in those regions which would be capable of gradual development. A point to be remembered is the dearth of trained physicists.

Under present conditions it is difficult to get routine observations made more than once a day in New Zealand.

Subject to the limitations imposed by conditions such as the above, it should be possible to secure uniformity of methods.

The more important experimental stations all maintain Meteorological stations equipped with varying degrees of completeness. The obstacles to advance are generally due to the difficulty of assigning a member of the staff with proper training to the taking and using of meteorological observations. The records from recording instruments are seldom tabulated in detail. The meteorological results are rarely discussed fully in connection with crop data. The quality of the data suffers through the lack of continuous use of it.

B. WEATHER FORECASTS

For forecasting purposes reports are received in the morning from a close network of stations in New Zealand, from Chatham and Norfolk Islands, from 14 Australian stations and from vessels in surrounding ocean waters. A forecast is issued at about noon and is telegraphed to approximately 200 towns in the Dominion. For the purposes of the forecast the country is divided into sixteen separate district, some of which can, if necessary, be sub-divided, and a separate forecast issued for each.

The noon forecast is displayed at Post Offices, is printed in most of the evening papers and can be obtained by telephone subscribers on ringing Post Office which receive it telegraphically.

A second forecast based on 4 p.m. observations is issued in the evening. Reports are received from Sydney, Hobart, Norfolk Island, Chatham Island and a satisfactory network of New Zealand stations. A summary of the general situation and forecast are prepared before 18.00 hours. This report, together with observations from sufficient stations to enable a rough weather chart to be drawn is broadcasted in Morse from the Wellington Government wireless station and also at about 19.00 hours and 21.00 hours by the Radio Broadcasting Company's stations at Auckland, Wellington, Christchurch and Dunedin. The forecast is published in the morning newspapers.

For the reception and tabulation of the evening forecast and reports, forms are supplied at cost price. These forms include a map on which the weather chart can be plotted.

Any farmer requiring a forecast for a special purpose, or wishing to be given warning of certain types of weather, can secure such service by payment of the cost of the necessary telegrams. This arrangement is a most valuable one to farmers at shearing time when cold, wet weather may cause the loss of hundreds of newly shorn sheep, if turned out into it. It is also helpful in connection with the cutting of hay and some other crops, the burning off of bush and scrub, the shifting of stock from regions likely to receive snowfalls, etc.

During the present year experiments have been made in issuing special forecasts for wheat growers during harvest and for fruit growers in the picking season. In these forecasts an attempt was made to indicate the weather for several days in advance and especially to give warning of major changes such as the advent of heavy rain, cold snaps, gales, etc. These forecasts were appreciated by farmers. Useful work on similar lines could, no doubt, be done at shearing, lambing and seeding times.

From the meteorological point of view the possibilities in this direction vary with the season of the year. At some times changes are very rapid and will advance from Western Australia, say, in two days, while at others they will take seven or eight days.

No attempt has been made to accompany forecasts by advice of an agricultural character. This would not appear possible without the addition to the staff of one or more specially trained Agricultural Meteorologists. An officer who had made a study of the problems of each district, and was familiar with all the farming activities and with the influence of the weather on them, could frequently give very valuable advice. Hundreds of sheep are lost at shearing time, for instance, through exposure to heavy rain and cold weather. Much of the spraying of orchards, potato crops, etc. is rendered useless by heavy rain following immediately on it. Fruit picking should frequently be accelerated if gales or heavy rain are to be expected. A good man could find many ways in which to assist by timely advice.

C. CROP FORECASTS AND ESTIMATES.

Very little has been done in the way of making crop estimates. Owing to the general absence of extreme conditions in New Zealand, it seems doubtful whether success is likely to be so great as in most countries. It is probable, also, that the preparation of estimates of the desired accuracy, a long period in advance of the harvest, will not be feasible. The number of factors determining the yield is large and the range generally small.

D. AGRICULTURAL METEOROLOGICAL RESEARCH.

(a) Soils and manures: While soil and manure studies have been in progress in New Zealand for some time their connection with meteorological factors has been treated in a general way only. As yet only small portions of New Zealand have been subjected to soil survey, yet within the compass of the Dominion there is an exceedingly wide range of soil types whose productivity in many cases is dependent upon the meteorological conditions prevailing, rather than on their own inherent fertility. There is urgent need for some ready way of determining the moisture content of the soil and the fluctuations which occur in such a moisture content. This matter is now being specially investigated and a promising method of rapid moisture determinations is being studied.

In the dairying and sheep raising areas of the North Island the application of fertilisers is very general and has been productive of good results. This practice of applying top-dressing fertilisers is rapidly extending both to the hilly districts of the North Island and over the South Island generally. It is estimated that some 2,000,000 acres of the Dominion receive some top-dressing fertiliser annually. These applications, beyond the normal increase of grass produced, are productive of striking improvements in animal health. While it is realized that meteorological conditions play a great part in determining the most appropriate dates for applying these manures, no definite research has been completed along these lines. With the increased use of nitrogenous manures and the practice of intensively grazing grass pastures - two factors in farm management which seem likely to give decidedly good results in New Zealand - there is urgent need for increased meteorological attention being given to ascertaining the best dates on which to apply various types of fertilisers, the period required for fertiliser effects to become apparent at different seasons of the year and under different weather conditions. A beginning with this work has been made at the Plant Research Station, Palmerston North, where a completely equipped agricultural meteorological observation station has been established by the Department of Scientific and Industrial Research.

(b) Plant Physiology: The relation of weather to plant structure has only been very generally studied. However, attention has been drawn from time to time to the peculiar variations in the nutritive quality of pasture grass in various seasons of the year. It is alleged, for instance, that excessive protein content of spring and autumn flush growths of grass are responsible for a disease known as 'Pulpy Kidney' which is responsible for a fairly high mortality in lambs and hoggets. In the wide range of latitude occurring in New Zealand, climatic conditions play a fairly important part in modifying plant physiology in order to secure adaptation to local circumstances, but these modifications are not always without disadvantage; e.g., the feeding value of oatshaf, chaff from oats grown in the Auckland Province, latitude 36-38, has apparently lower feeding value than that grown in the South Island, latitude 41-46.

(c) Plant Breeding and Crop Varieties: Only within the last few years has any systematic attempt been made to undertake plant breeding in New Zealand. The work at present being done concerns wheat, oats, and *Phormium tenax*. A considerable amount of plant selection is also being done and in this connection considerable attention is being devoted to the ecological factors influencing plant growth. General meteorological conditions only, however, are being taken into account, but both at Lincoln College and at the Plant Research Station, Palmerston North, the meteorological side could be fairly readily given further attention.

(d) Fruit growing: Experiments are being made on a considerable scale in Central Otago with methods of protecting orchards (stone fruit) against frost. Some experiments on a smaller scale have been made, also, in Hawkes Bay. Artificial heating is used by some growers in both districts. The only other forms of protection used are such as the planting of tree shelters, the use of scrim over seedlings, etc.

(e) Entomology: (f) Mycology. Entomological and mycological research, in so far as these subjects affect agricultural plants, is at present being conducted at Cawthron Institute and at the Plant Research Station. In both cases no special attention is being given to the influence of meteorological conditions upon the development either of insects or of fungi. There is no doubt that additional attention given to these factors would assist in the forecasting of probable prevalence of many plant diseases and render possible various protection and remedial measures on the part of farmers. There is much annual loss in the Dominion through insect and fungous pests and the selection of the most appropriate times for spraying, etc., would be greatly facilitated by a better knowledge of the relation of weather conditions to fungus and insect development.

(g) Animal nutrition, distribution, etc: This matter has received comparatively little attention in the Dominion although climatic conditions are probably the main factor controlling the distribution of the various breeds of animals and varieties of plants. Recently some doubt has been raised as to whether the present distribution is likely to prove the best in the long run. For example, over a wide range of soil and climatic types in the North Island the Romney Marsh breed of sheep predominates, almost to the exclusion of other breeds. Within this breed there has apparently developed different types of wool and some deterioration in wool quality is alleged. The question arises as to whether this is due to the maintenance of Romney sheep on pasture country for which, by reason of soil or climatic conditions, they are not suited. For obvious reasons, some attempt has been made to restrict the number of breeds of cattle, sheep and pigs in New Zealand, but whether this is likely to prove the best in the long run is doubtful, as it is realized that it involves raising difficulties which occur when old established breeds are forced to acclimatize themselves to conditions for which perhaps they are not climatically suited.

(h) Phenological observations.

Phenological observations have not yet been undertaken and their organization would be a slow and difficult process. It would first have to be decided whether native or introduced plants or a combination of each were to be used. The choice of the actual phenomena will be very difficult. What constitutes the strength of the New Zealand climate is the fact that in most districts growth is possible almost throughout the year. The characteristic evergreen flora is perhaps largely a result of this. Nevertheless, when a satisfactory system of phenomena has been arrived at, regular observations in New Zealand should be extremely interesting.

There are many avenues for research in Agricultural Meteorology. The chief difficulty encountered will be the absence of reliable and homogeneous series of data covering long periods. Among the subjects to be investigated are -

(a) Correlations between weather and yields of all kinds, including Wool and Meat.

(b) The determination of the relationship between climatic factors and the uses to which the land is or should be put, e.g. the areas where it is profitable to grow forests, pasture, wheat, oats, barley or maize, etc. and the best types to be grown.

(c) The relations between climatic factors and diseases, insect pests, etc. Determination of critical temperatures, etc. for various vegetable and animal pests.

(d) The study of the whole subject of water content and water functions in the soil.

(e) Investigations into the possibility of seasonal forecasting. The prospects are not promising, but negative evidence would be valuable in preventing exploitation of the farming community by pseudo-scientists.

(f) The prediction of minimum temperatures with a view to frost protection.

